

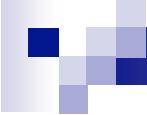


Energy and Environmental Economics, Inc.

# Local Value of Renewable Distributed Generation

July 1, 2005 California Energy Commission

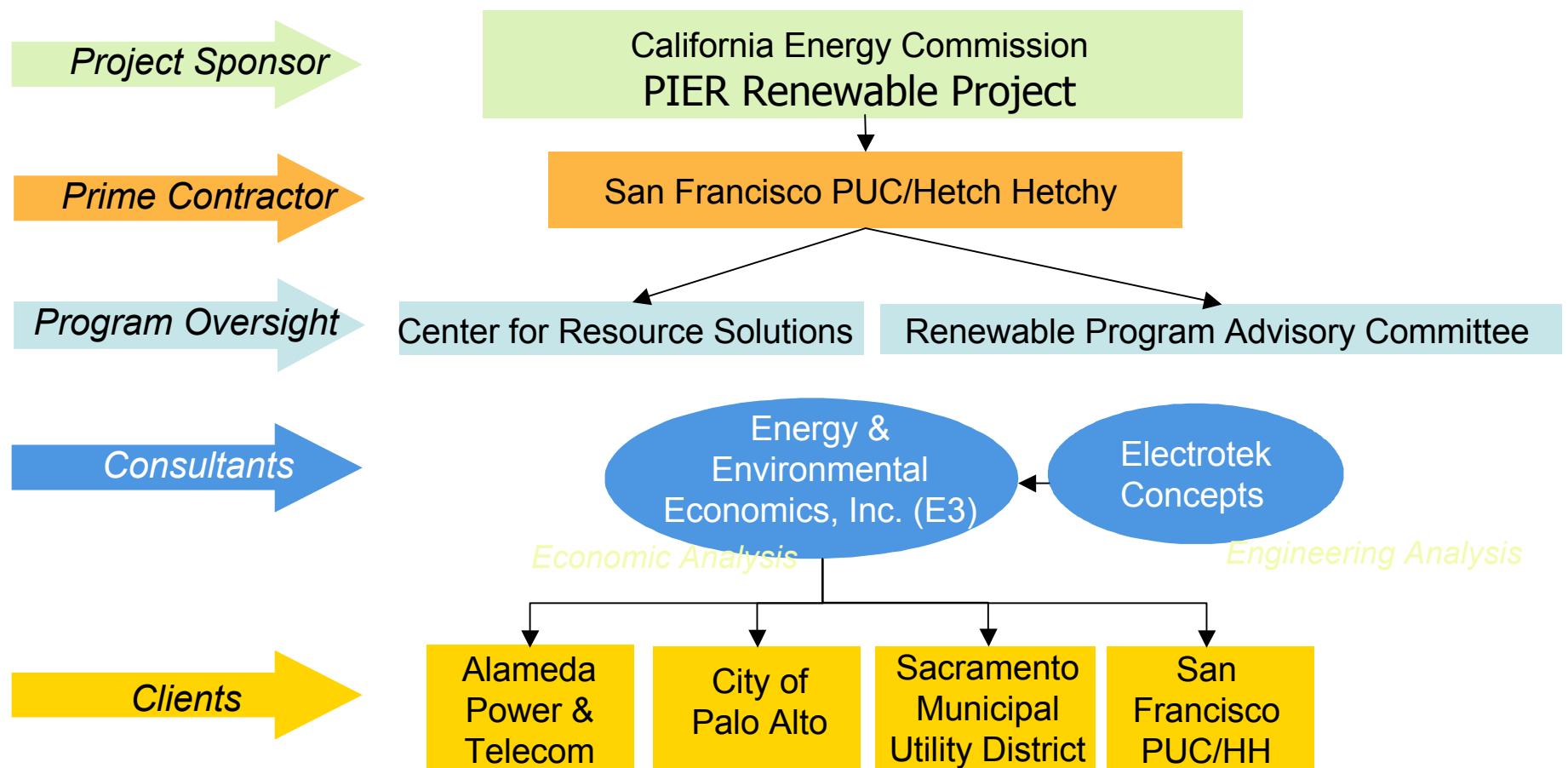
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# Overview of Presentation

- Overview of the RDG Assessment Project
  - Project Structure – Research Partners
  - Technologies
  - Overview of Results
- Local value of RDG
  - Capital deferral
  - Reliability
  - Losses
  - Environment and intangibles

# Project Organization



# Economic Model Summary Output

	TRC Cost Test	Participant (Customer or Merchant)	RIM Test (Customer Owned)	UCT Test (Utility Owned)
Biogas - 10kW PEM Fuel Cell	0.01	0.01	0.75	0.01
Biogas - 10kW PEM Fuel Cell CHP	0.39	0.44	0.73	0.33
Biogas - 100kW SOFC Fuel Cell	0.02	0.02	0.75	0.02
Biogas - 100kW SOFC Fuel Cell CHP	0.55	0.63	0.73	0.47
Biogas - 200kW PAFC Fuel Cell	0.01	0.02	0.75	0.01
Biogas - 200kW PAFC Fuel Cell CHP	0.48	0.55	0.73	0.41
Biogas - 200kW PEM Fuel Cell	0.02	0.02	0.75	0.02
Biogas - 200kW PEM Fuel Cell CHP	0.54	0.62	0.73	0.46
Biogas - 250kW MCFC Fuel Cell	0.01	0.01	0.75	0.01
Biogas - 250kW MCFC Fuel Cell CHP	0.40	0.46	0.73	0.34
Biogas - 30 kW Capstone 330 Microturbine	0.03	0.03	0.75	0.03
Biogas - 30 kW Capstone 330 Microturbine w/ CHP	0.65	0.74	0.73	0.54
Biogas - 500 kW Gas Recip GA-K-500	0.06	0.06	0.75	0.05
Biogas - 800kW Caterpillar G3516 LE	0.08	0.09	0.75	0.08
Biogas - 800kW Caterpillar G3516 LE w/CHP	<b>1.08</b>	<b>1.23</b>	0.73	0.86
Biogas - 3MW Caterpillar G3616 LE	0.09	0.09	0.75	0.08
Biogas - 3MW Caterpillar G3616 LE w/CHP	<b>1.10</b>	<b>1.26</b>	0.73	0.87
Biogas - 5MW Wartsila 5238 LN	0.74	0.85	0.73	0.57
Biogas - MSW Gassification	0.41	0.35		0.49
Biodiesel - 500kW DE-K-500	0.12	0.13	0.77	0.11
Solar - PV-5 kW	0.16	0.21	0.57	0.16
Solar - PV-50 kW	0.21	0.20	0.79	0.21
Solar - PV-100 kW	0.21	0.20	0.79	0.21
Solar - Thermal SAIC SunDish 25 kW	0.15	0.14		0.24
Wind - Bergey WD -10kW	0.13	0.15	0.70	0.13
Wind - GE 750 kW	0.91	0.91		<b>1.47</b>
Wind - GE 1.5 MW	<b>1.08</b>	<b>1.08</b>		<b>1.72</b>

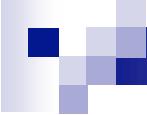


# Key Results

- Difficult to find cost-effective RDG on a net benefit basis
  - Avoided costs too low
  - RDG capital costs too high
- Indirect benefit value must be high
- Cost-effective technologies tended to be combined heat and power applications
- If sited in the best location RDG can provide benefits to distribution systems with regard to:
  - Capacity release
  - Peak loss reduction
  - Reliability improvement



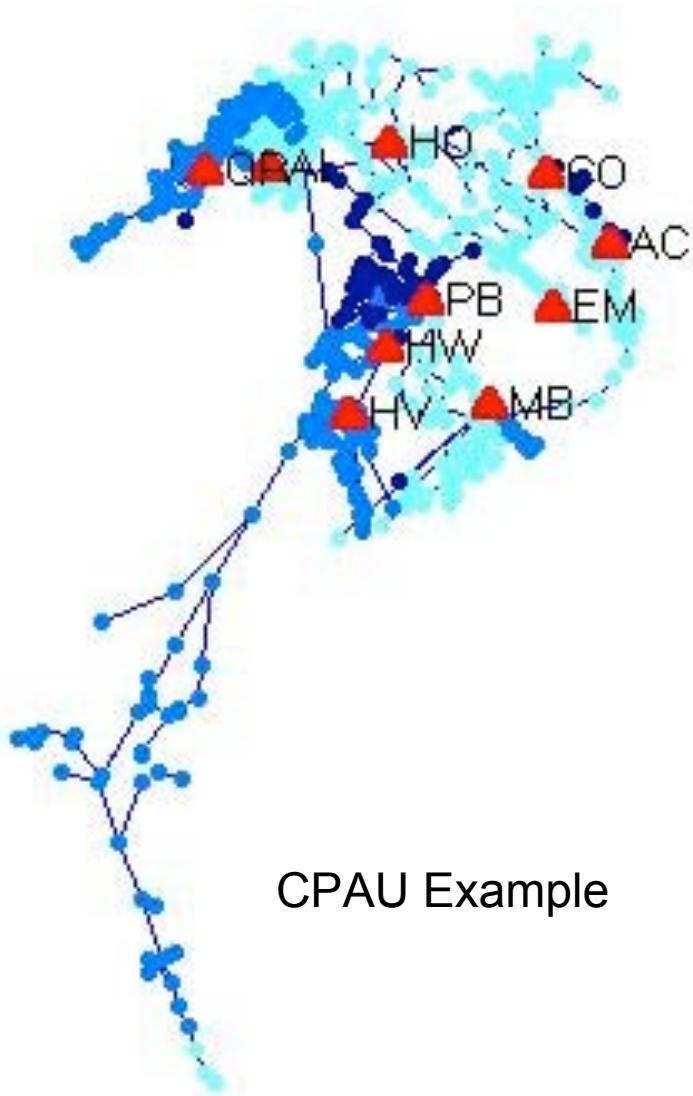
# Distribution Value



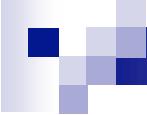
# Project Perspective

- For each utility, our project team worked with utility engineers and used engineering tools to determine the best locations on the system.
- Value is very dependent on location and without utility planning involved, difficult to identify the high value locations.

# Siting Analysis: Finding Optimal Locations for RDG

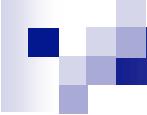


Darker colors indicate more optimal locations for a large DG (2 MW) with respect to released capacity



# Major Components of Local Value

- Capital Deferral
- Loss Savings
- Indirect Benefits
- Reliability

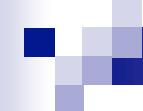


# Capital Deferral Benefits

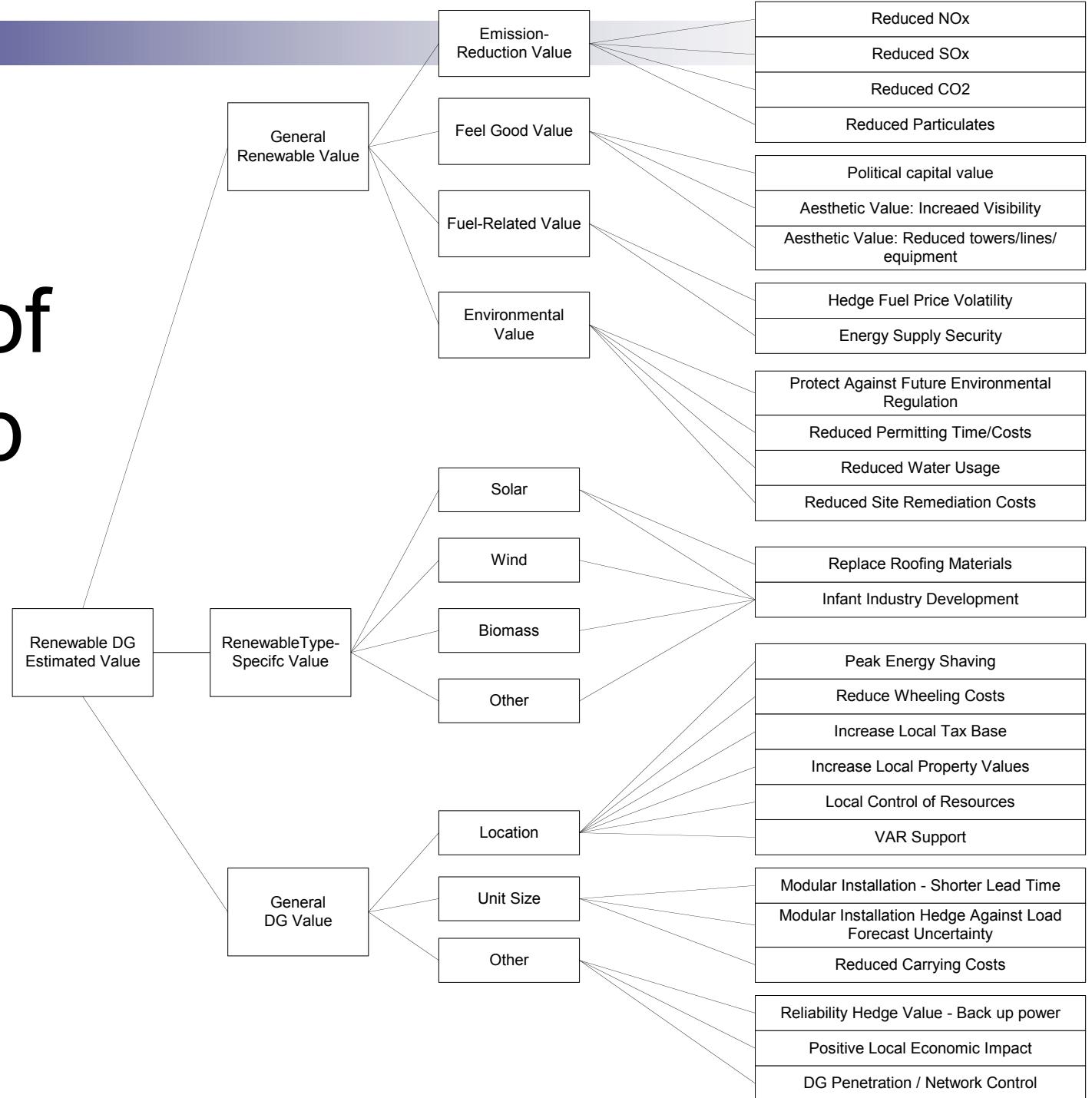
- Not as much capital deferral potential as we expected.
- Load now recovering in post-2002 in Bay Area Utilities
  - Alameda and Palo Alto
- SMUD had identifiable capacity upgrades it could defer
  - Small value – order of \$2/kW-year of benefit
- Hunter's Point Naval Shipyard
  - Higher potential value as part of a redevelopment project and avoiding new infrastructure build

# Annual Peak Loss Savings for DG Cases – Palo Alto Example

Case	Annual Loss Savings		% of gen kWh	Peak Loss Savings	
	kWh	%		kW	%
4 MW Distributed PV	178886.4	1.2	2.5	92	1.9
2 MW CHP Peaker @ VA	15674.68	0.1	5.7	101	2.1
2 MW CHP Baseload @ VA	582253.8	3.8	3.3	134	2.8
10 MW Optimal Gens	2807168	18.6	3.2	699	14.5
10 MW CHP @ VA Hosp	325375	2.2	0.4	262	5.5
10 MW CHP QR Sub	666364	4.4	0.8	233	4.8
Pump Regen Case	29710.15	0.2	2.8	2	0.0
CPAU PV Case	19467.12	0.1	1.9	10	0.2

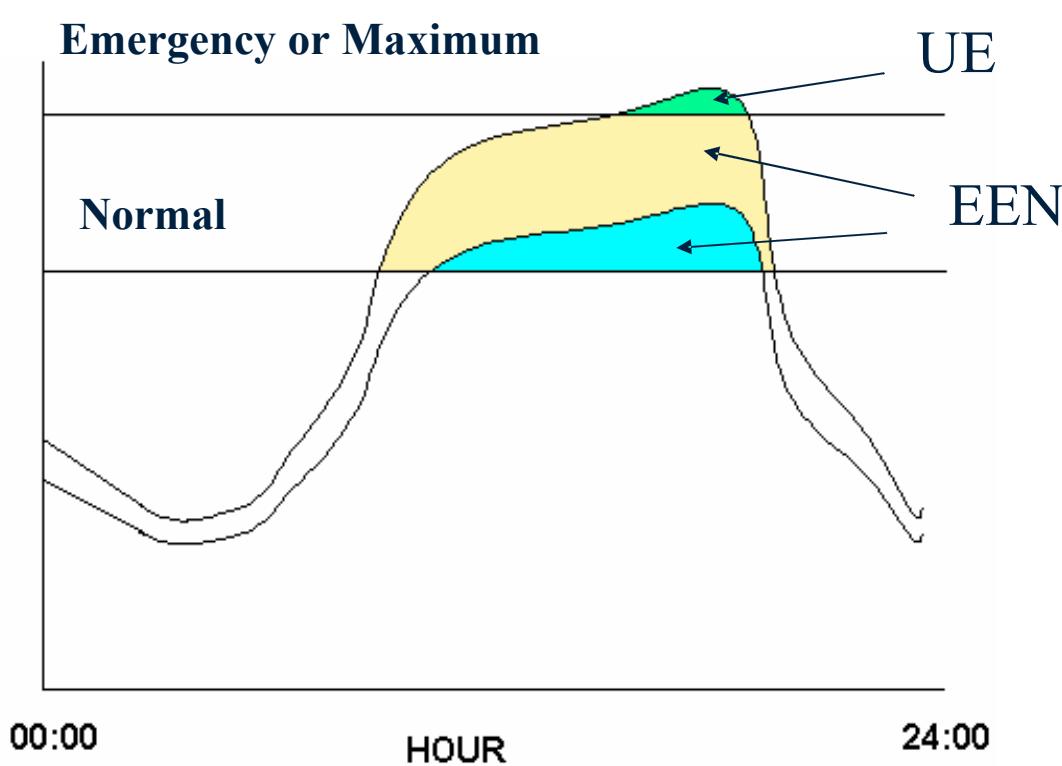


# Indirect Benefits of RDG Map



# Reliability Analysis-Basic Concept

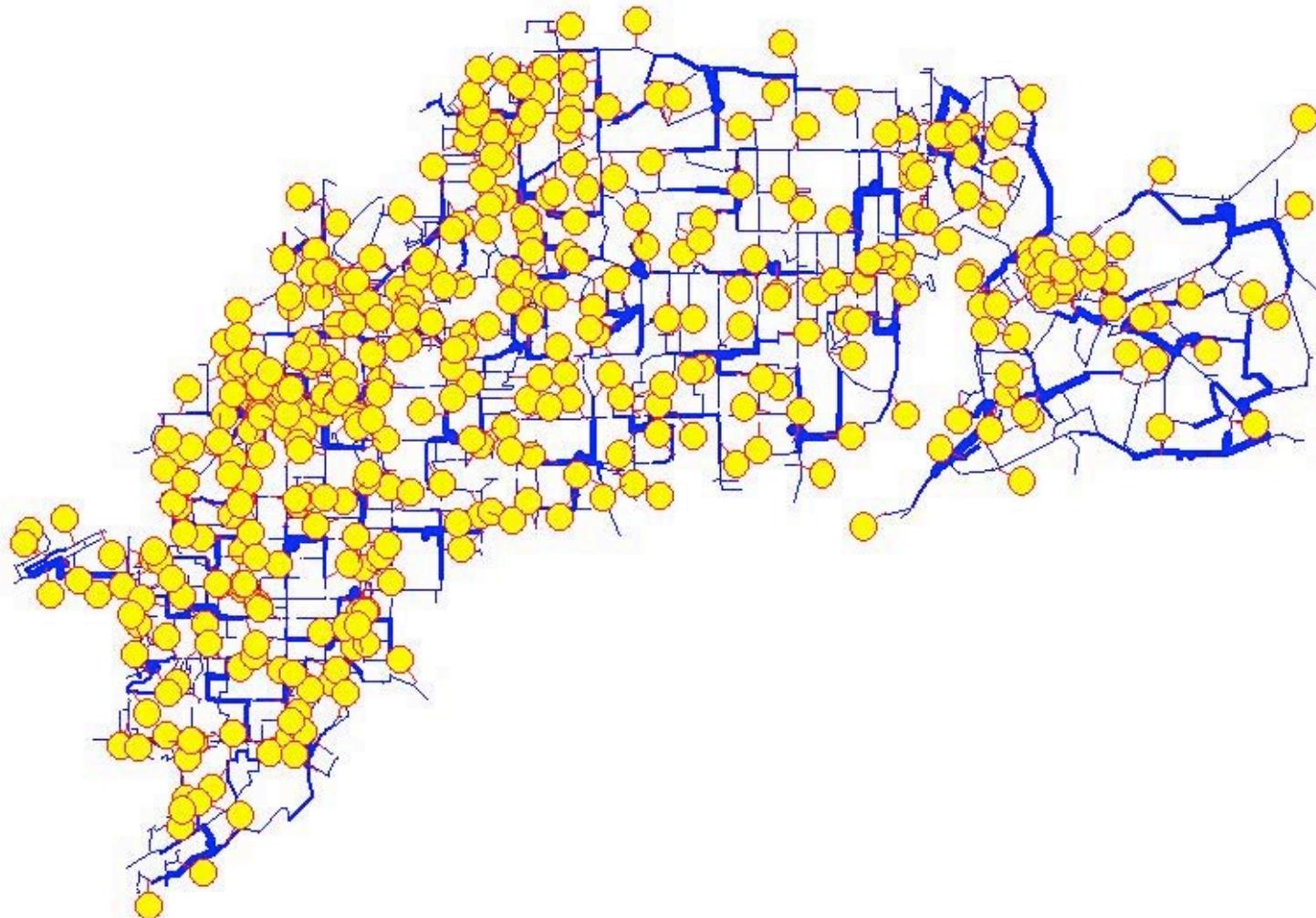
- Hourly load-flow example for a peak day

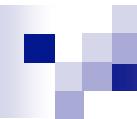


- Calculate UE and EEN with renewable DG operating
- Allows quantification and costing of reliability benefits

UE = Unserved Energy, EEN = Energy Exceeding Normal

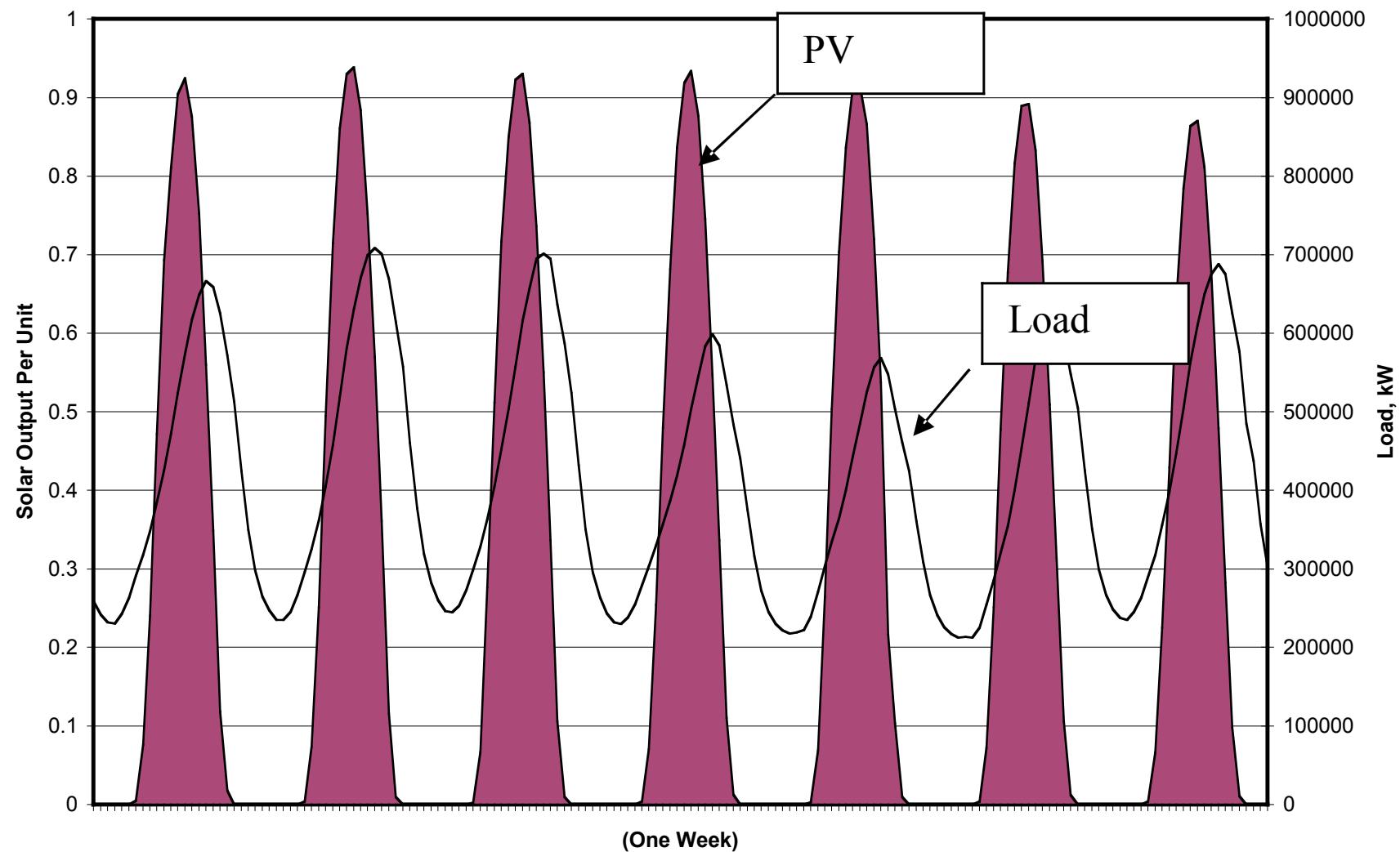
# Case 4: 20 MW of Distributed PV





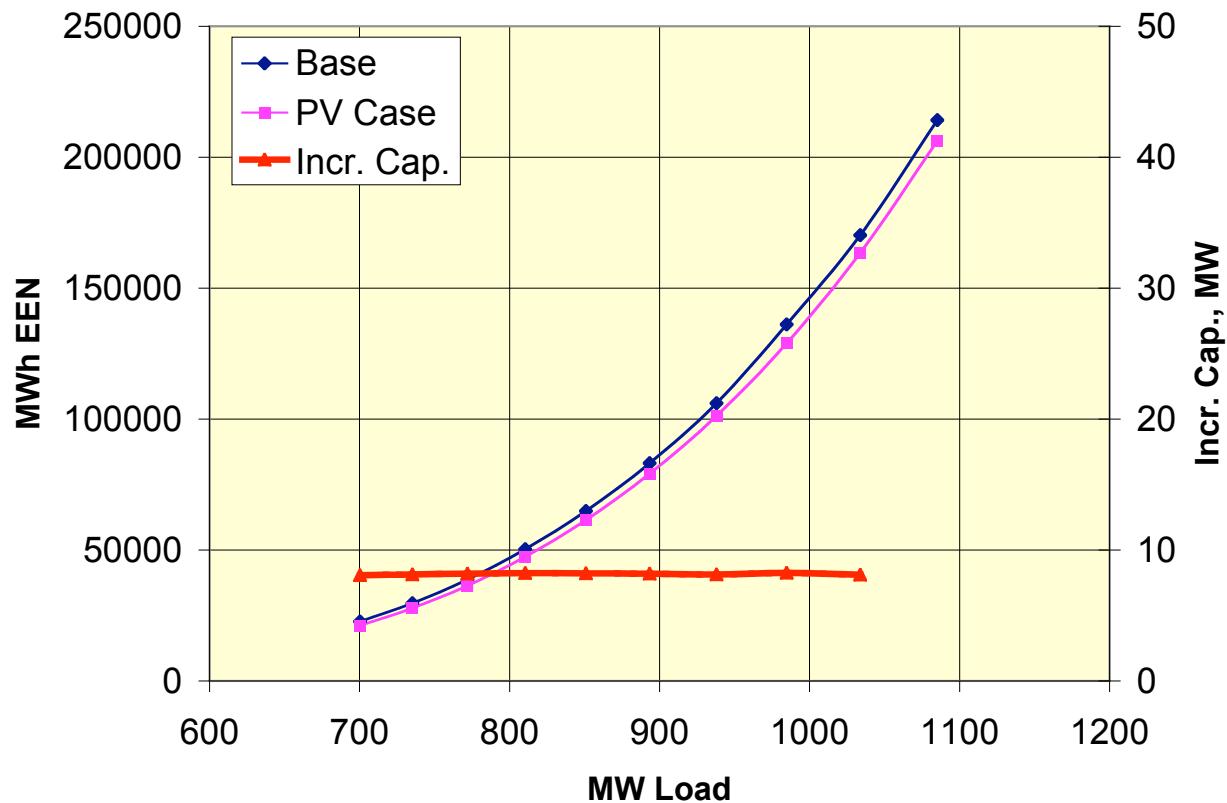
# SMUD Load Shape & PV Generation Shape

SMUD Load Shape & PV Gen Shape



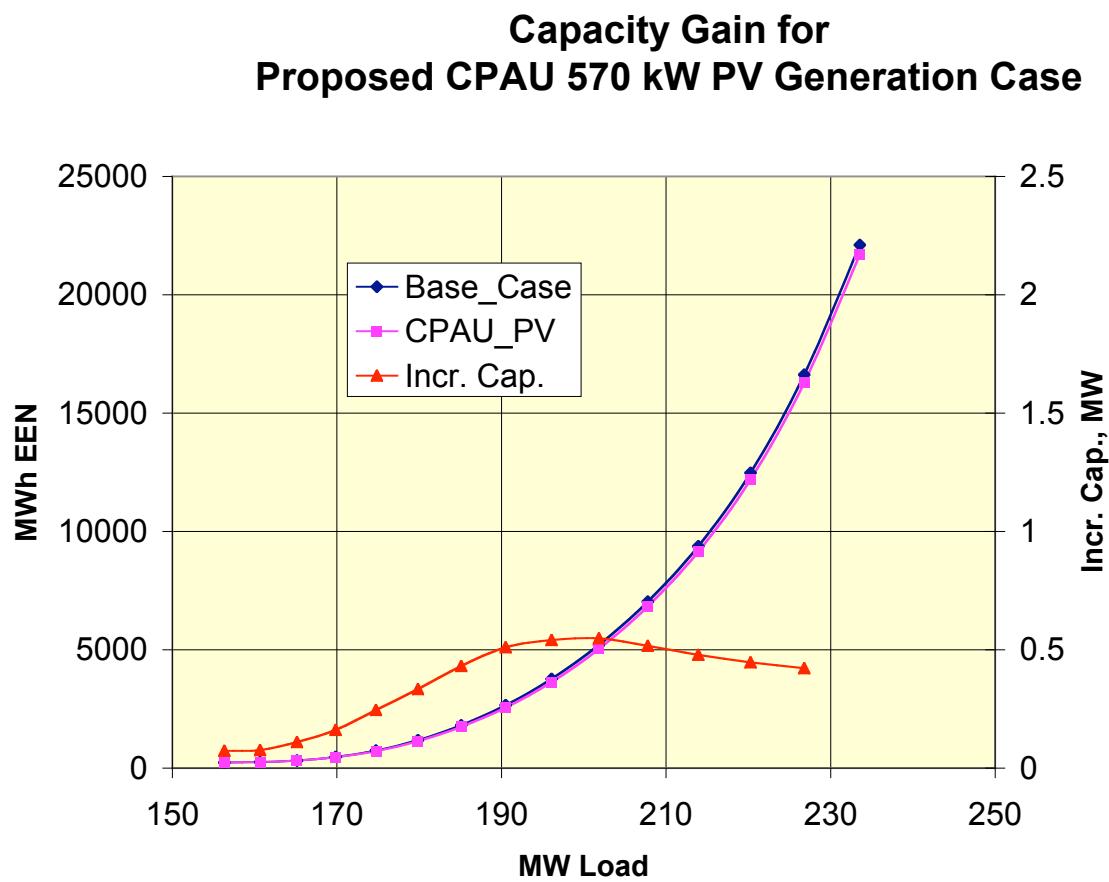
# Capacity Gain with 20 MW of Evenly Distributed Solar PV – SMUD Example

Capacity Gain for  
20 MW Dispersed Solar PV



# Capacity Gain with 570kW Solar PV

## *CPAU Example – Best Locations*



# Questions?

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